AD NUMBER

AD390001

CLASSIFICATION CHANGES

TO: unclassified

FROM: confidential

LIMITATION CHANGES

TO:

Approved for public release, distribution unlimited

FROM:

Distribution authorized to U.S. Gov't. agencies and their contractors; Critical Technology; Mar 1968. Other requests shall be referred to Air Force Armament Laboratory [AFAL], [AFSC], Eglin AFB, FL.

AUTHORITY

AFAL ltr, 16 Sep 1968; ADTC/USAF ltr, 5 Sep 1974

AFATL-TR-68-37

Skin Irritant Decontaminant (SID) (U)

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TECHNICAL REPORT NO. AFATL-TR-68-37
MARCH 1968

AIR FORCE ARMAMENT LABORATORY
AIR FORCE SYSTEMS COMMAND
EGLIN AIR FORCE BASE, FLORIDA

See Form 1473

SKIN IRRITANT DECONTAMINANT (SID) (U)

by
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FOREWORD

(U) This report was prepared by the CB Defense Branch, Bio-Chemical Division, Air Force Armament Laboratory. Active USAF projects which are directly related to the information discussed herein are Exploratory Development Project 2534, Advanced Development Plan for ADO 43, and Engineering Development RAD 3764. Further detailed information or comments on any portion of this report may be referred to AFATL (ATCD), Eglin AFB, Florida 32542. Request from non-DOD agencies should be based on a need to know.

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(U) This technical report has been reviewed and is approved.

JOHN E. HICKS, Colonel, USAF
Chief, Bio-Chemical Division

ABSTRACT

(C) An improved skin decontaminant for CS, CN, and related chemicals has been developed. This decontaminant consists of 5% sodium bisulfite by weight dissolved in a mixture of 45% isopropyl alcohol, 40% water, and 10 percent glycerin by volume. This solution is highly effective in relieving the skin irritating effects of the riot control agents CS and CN.

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SECTION I

INTRODUCTION

(U) The objective of this project was to develop a non-toxic solution that could be applied to the skin of personnel after exposure to CS-1 and CS-2 riot control agents to prevent or relieve the skin irritating effects produced by them.

BACKGROUND

(U) Extensive testing at Eglin Air Force Base, Florida, with the incapacitating agents CS-1 and CS-2 demonstrated the need for more effective decontaminating agents for application on both personnel and equipment. An effective decontaminant for the use on aircraft and equipment was developed using monoethanolamine (MEA) as the active component. MEA is not effective in relieving skin irritations caused by CS; therefore, an additional solution was developed for skin decontamination.[1]

(U) In an effort to develop a decontaminant, a laboratory investigation was undertaken to: (1) Determine if the skin irritating effects of CS were due to CS agent, to CS breakdown products, or to a combination of both. (2) Develop a CS neutralizing solution that could be applied to the skin.

SECTION II

LABORATORY TESTS

(U) Laboratory investigations were conducted employing the method of gas chromatography for determining CS and CS hydrolysis products. A Micro Tek MT-220 gas chromatograph, equipped with dual hydrogen flame detectors and 6-foot columns packed with 5% SE-30 on 80/90 chromport XXX with temperatures programmed from 80° to 250°C at the rate of 20°C/minute, was used for all analysis.

(C) The skin irritating effects of freshly prepared (1 minute) and aged (24 hours) aqueous samples of CS-1 were compared. The skin of human volunteers on which 24-hour samples were applied began to burn and sting more rapidly and severely than the skin on which 1-minute samples were applied. Samples (0.3 microliter) from both water tests were injected into the gas chromatograph, and the peaks obtained indicated the 24-hour samples had undergone partial hydrolysis as demonstrated by the presence of O-chlorobenzaldehyde and malononitril (peaks were established with both products before water test samples were injected), while no hydrolysis could be detected in the 1-minute samples (See Figures 1, 2, and 3).

(C) O-chlorobenzaldehyde and malononitrile were also applied in very small amounts to human skin to determine their skin-irritating effects. O-chlorobenzaldehyde demonstrated the same irritating effects as found with CS, but malononitrile failed to demonstrate such irritating effects.

(C) A small amount of the aldehyde was then added to water solution of 5% by weight sodium bisulfite in an effort to neutralize the irritating effects. Since O-chlorobenzaldehyde is not miscible with the aqueous-bisulfite solution, a non-skin irritating solvent, isopropyl alcohol, was added. A solution containing 5% sodium bisulfite by weight in a mixture of 45% isopropyl alcohol, 45% water, and 10% glycerin by volume was found to be very effective in neutralizing the skin irritating effects of O-chlorobenzaldehyde, CS and CN. The alcohol was added to increase the solubility and reaction rates of the bisulfite solutions with the irritating agents, while the glycerin was added to reduce the skin evaporation rate and to act as a stabilizer to keep the bisulfite in solution.

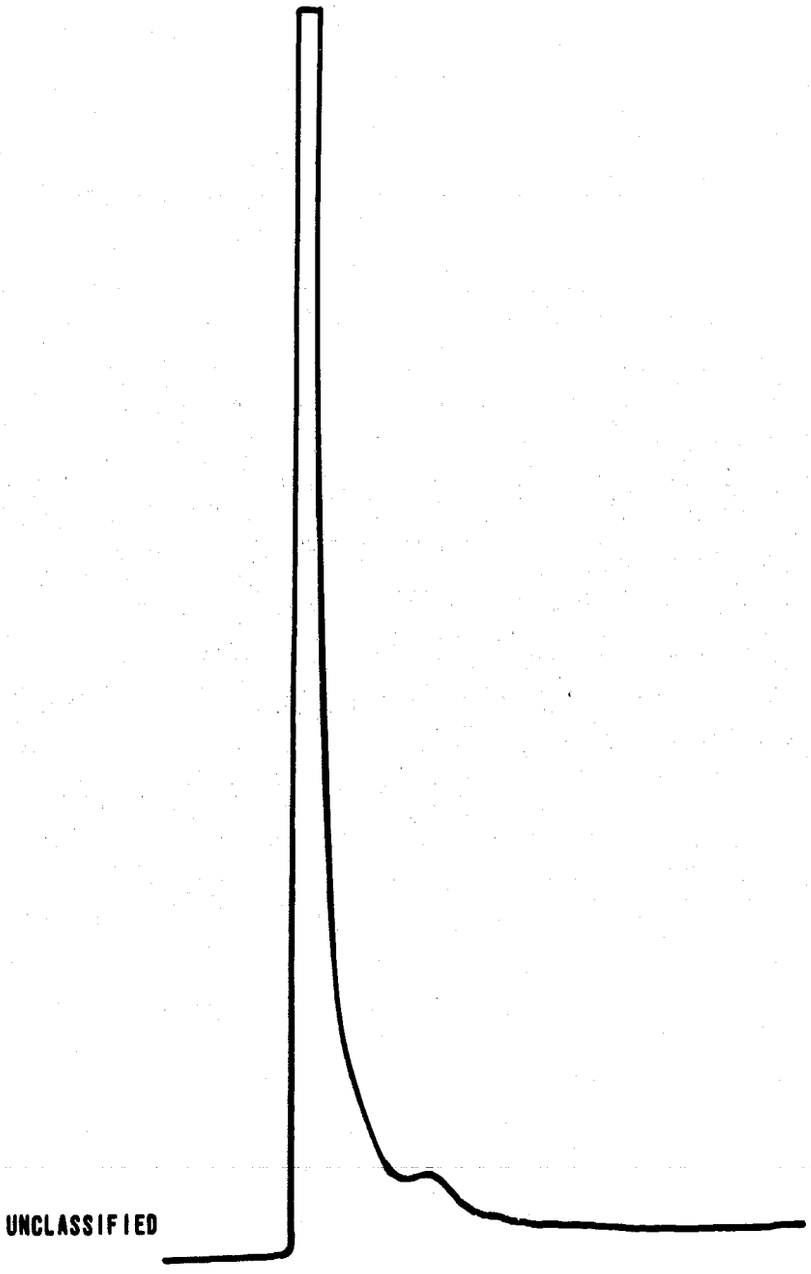

Figure 1. Control: Malononitrile.

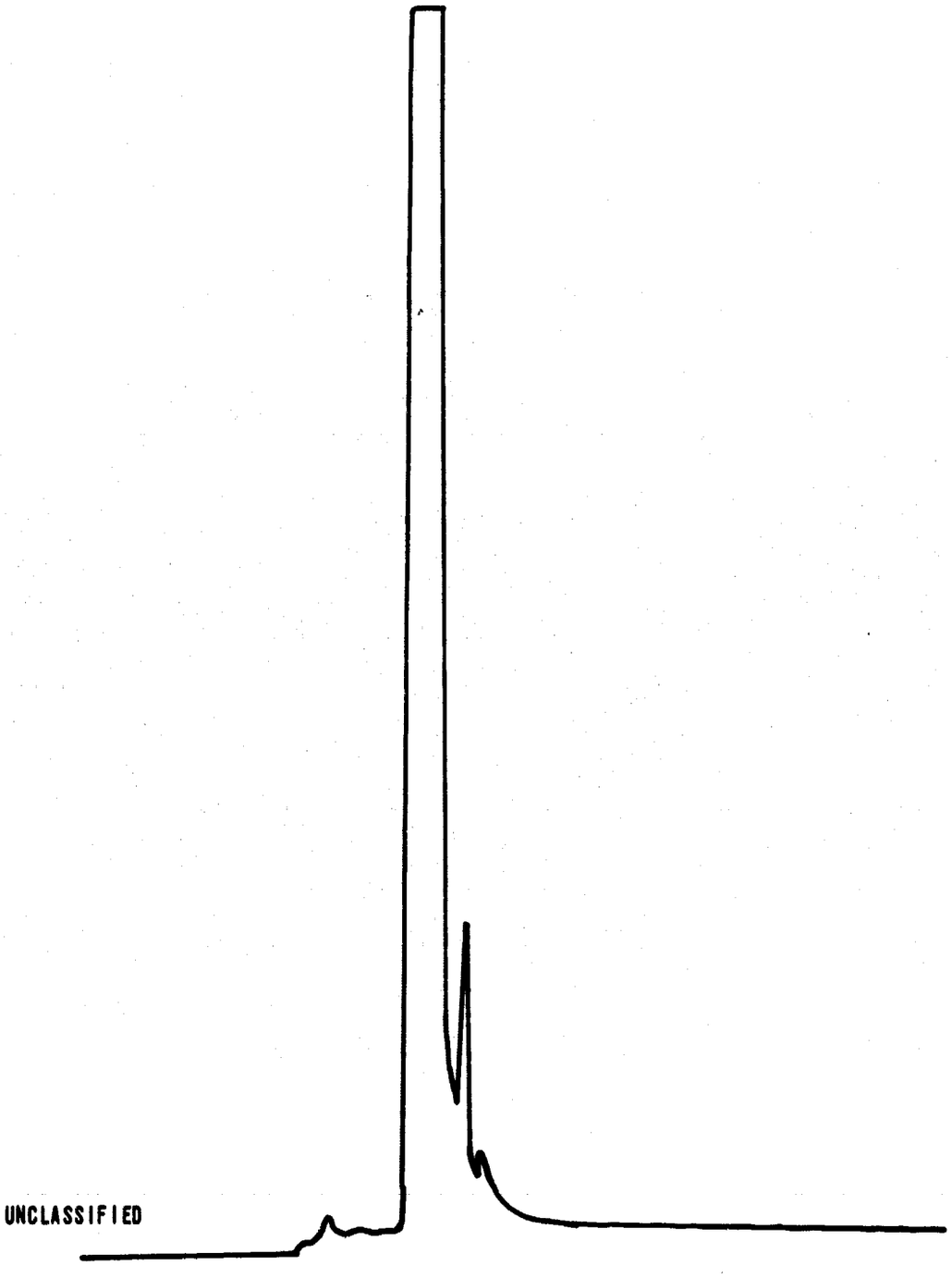

Figure 2. Control: O-Chlorobenzaldehyde.

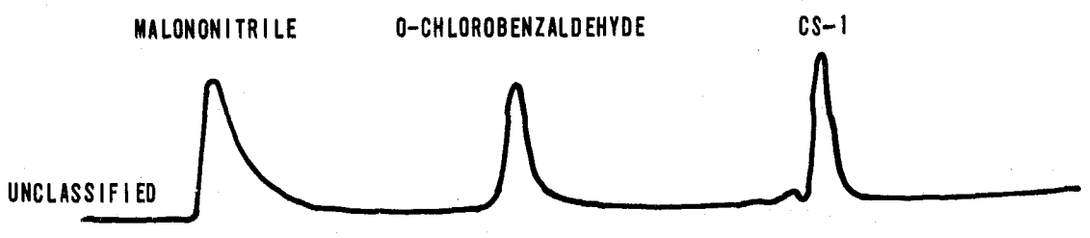

Figure 3. Partial Hydrolysis of CS-1 After 24 Hours in the Water.

(C) Although an aqueous sodium bisulfite solution has been recommended as a decontaminant in previous decontamination manuals, it is not an effective decontaminant.[2] An excess of 5% sodium bisulfite in water was added to a known quantity of CS (0.1576 gram) and allowed to react for 15 minutes. The remainder of the CS was extracted with butyl ether. Samples (0.3 microliter) from the extract were injected into the gas chromatograph, and the peaks obtained indicated that approximately 85 to 90% of the CS was still present. Similar analyses were performed using the bisulfite-alcohol-water-glycerin mixture with the same results (see Figures 4 and 5).

(C) A solution containing the bisulfite-alcohol-glycerin mixture was saturated with CS-1, and samples were applied to the skin of human volunteers with no irritating effects noted. After methylene chloride extraction and evaporation, the residue was mixed with water and applied to the skin resulting in typical CS-1 skin irritation symptoms. The ability of the bisulfite solution to neutralize skin irritating properties of CS without being an effective decontaminant demonstrates the importance of understanding the difference in applications of SID and the new Air Force decontaminant (MEA).[1]

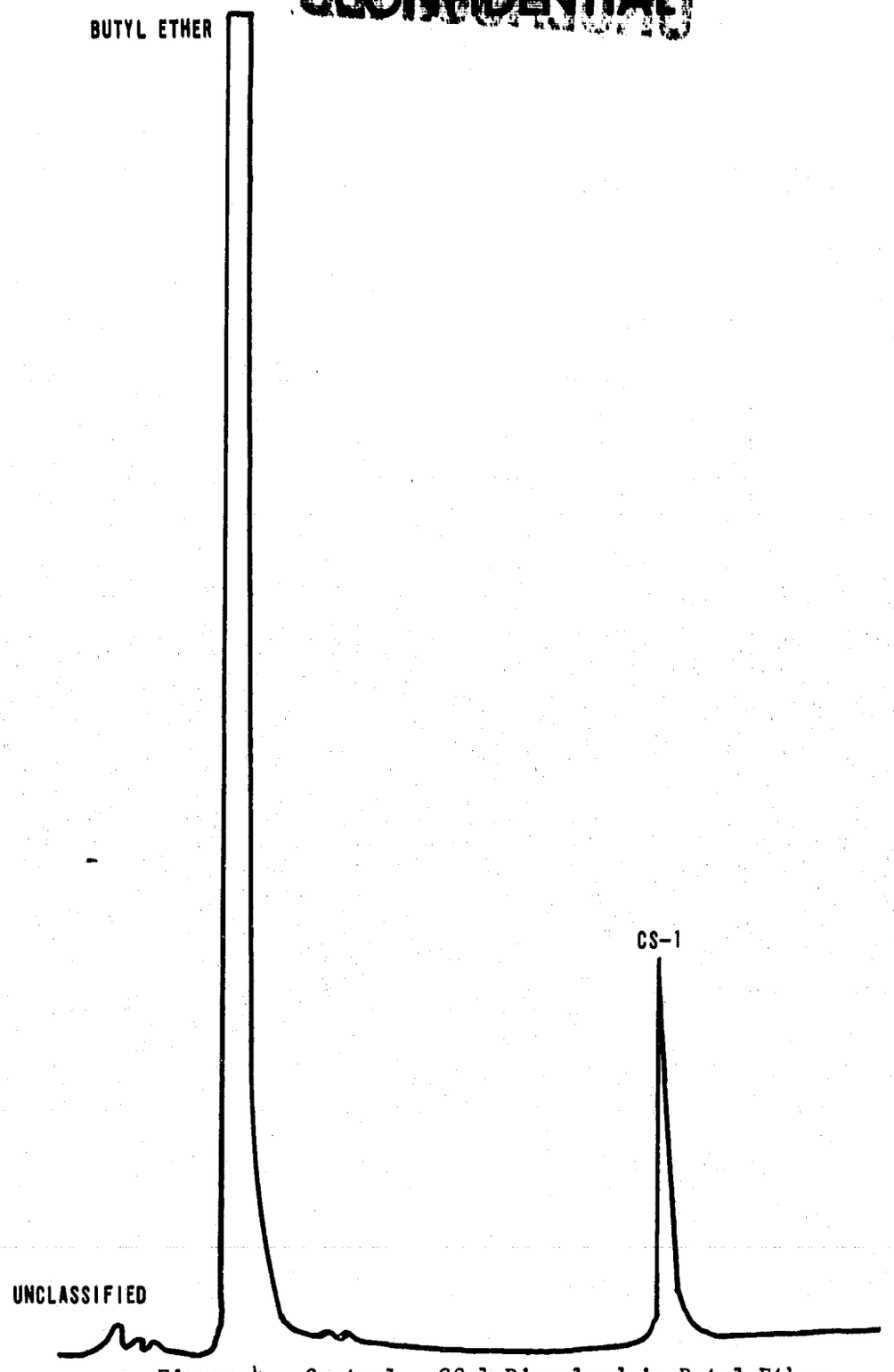

Figure 4. Control: CS-1 Dissolved in Butyl Ether.

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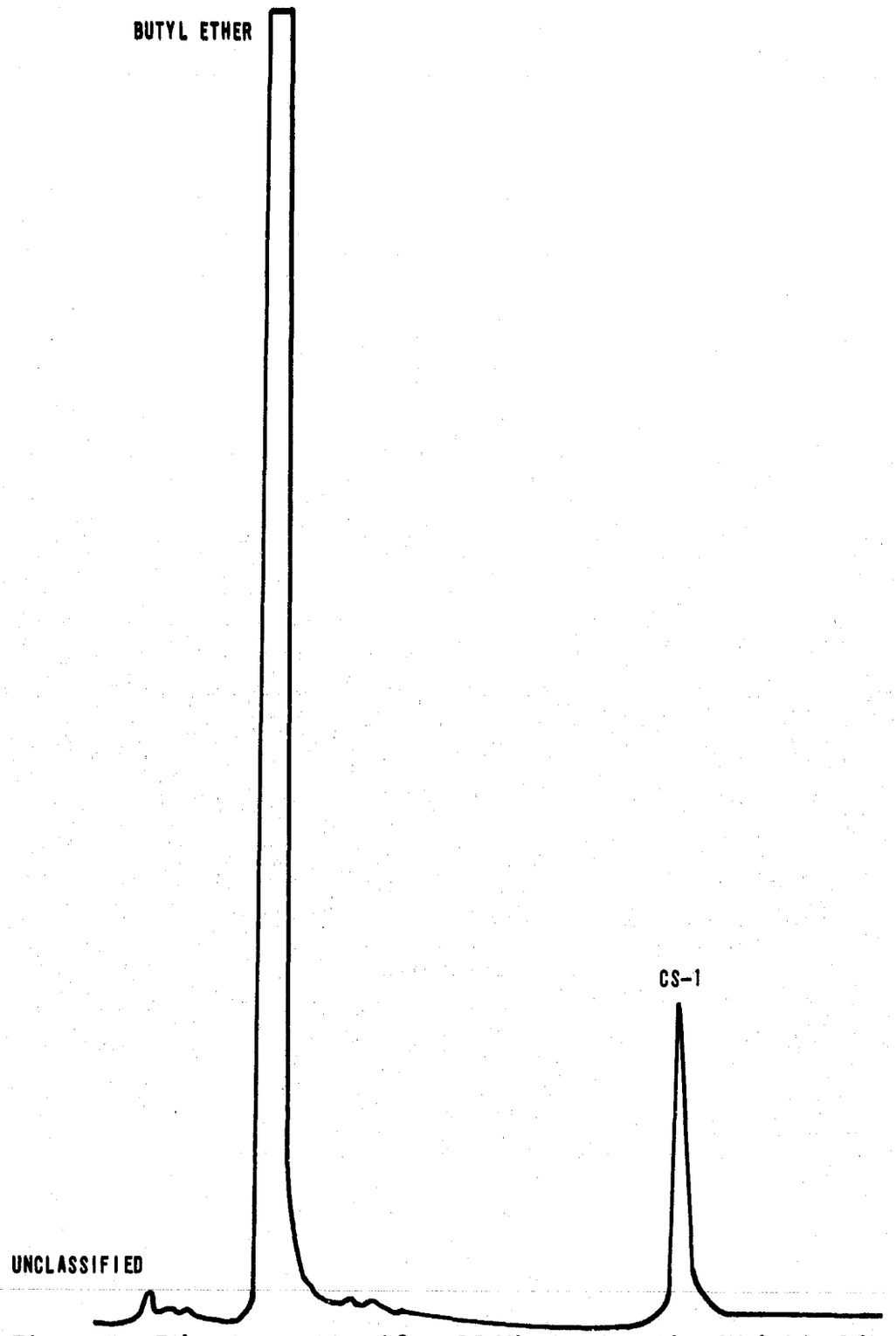

Figure 5. Ether Extraction After 15 Minutes Reaction With Bisulfite Solution.

SECTION III

TOXICITY TEST

(U) White mice and New Zealand rabbits were divided into groups and subjected to skin irritant decontaminant (SID). These laboratory animals were observed for two weeks to evaluate the toxicity of the decontaminant.

(U) Five mice, ranging in weight between 22 and 28 grams, had SID vigorously rubbed into their right ears. There were no unusual characteristics noticed either at the time of application or during the 14 days while under observation.

(U) New Zealand rabbits were exposed to SID by applying it to shaven areas of their backs and abdomens. During the 14-day observation period, no detectable evidence of toxicity or skin irritation was shown by the rabbits.

(U) Skin irritant decontaminant was placed under the nictitious membranes of the right eyes of New Zealand rabbits, ranging in weight between 662 and 776 grams. It was observed that SID had an immediate irritant quality probably associated with the isopropyl alcohol present in its formula. The irritation subsided within a few minutes. The only other noticeable characteristic was that the eyes discharged a clear watery secretion for approximately 1 hour. This secretion was probably a defense mechanism for the relief of the irritation. There was no observed damage or irritation to the eyes after 1 hour.

(U) A group of five mice weighing between 22 and 28 grams were exposed internally to SID after soaking their rations with the solution. These animals were given a 24-hour period to consume the food. During this period and for 14 days, these animals were kept under close observation to see if there was a toxic effect when SID was taken internally in small amounts. The body functions of these animals did not stray from the norms so it was assumed that SID, taken in small amounts internally, was not toxic to these laboratory animals.

(U) Prior to the toxicity test, all components of SID were researched to see in what capacity they were used in pharmaceuticals. All were used either singularly or in conjunction with other ingredients for application on the external surface of the body.

(U) The animals used in this project were housed and cared for as prescribed in the "Principles of Laboratory Animal Care," promulgated by the National Society for Medical Research.

SECTION IV

DISCUSSION

(C) An effective skin decontaminant for CS, CN, and irritating aldehydes has been developed. Evidence from experimental data obtained for this report suggest that the irritating effects of CS may be due, at least in part, to O-chlorobenzaldehyde, a breakdown product of CS.

(U) This solution along with the new Air Force CS decontaminant for aircraft, spills, and equipment will eliminate some of the problems encountered in working with CN, CS, and related agents. These decontaminants should also be beneficial to law enforcement officers throughout the world when using related riot control agents.

(U) SID should be sprayed from small aerosol containers or poured directly on the CS-contaminated skin from any small container and rubbed into the skin with the hand.

SECTION V

CONCLUSION

(C) A solution containing 5% sodium bisulfite by weight dissolved in a mixture of 45% isopropyl alcohol, 40% water and 10% glycerin by volume has been proven highly effective in neutralizing the skin irritating properties of CS, CN, and O-chlorobenzaldehyde when an excess of the decontaminant is used.

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2. TM 3-220, Chemical, Biological, and Radiological (CBR) Decontamination.

UNCLASSIFIED
Security Classification

UNCLASSIFIED

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)*
Air Proving Ground Center
Eglin Air Proving Ground Center

2a. REPORT SECURITY CLASSIFICATION
UNCLASSIFIED

2b. GROUP
Gp-4

3. REPORT TITLE
Skin Irritant Decontaminant (SID) (U).

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Final report.

5. AUTHOR(S) *(First name, middle initial, last name)*
B. C. Wolverton, S. N. Merrill, R. C. Voigt ~~AIC, USAF~~

6. REPORT DATE
~~April 1968~~ Mar 68

7a. TOTAL NO. OF PAGES
20

7b. NO. OF REFS
2

8a. CONTRACT OR GRANT NO.

b. PROJECT NO.
2534
AF-2534

c.

d.

9a. ORIGINATOR'S REPORT NUMBER(S)
AFATL-TR-68-37

9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*

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Available in DDC.

12. SPONSORING MILITARY ACTIVITY
Air Force Armament Laboratory (ATCD)
Eglin Air Force Base, Florida

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(400 936)

DD FORM 1 NOV 68 1473

UNCLASSIFIED
Security Classification

GP-4

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Skin Decontamination						
Riot Control Agents						
Gas Chromatography						
Glycerin						
Isopropyl Alcohol						
CS-10						
CS-2						
CN						
O-Chlorobenzaldehyde						
Sodium Bisulfite						
Non-Toxic						